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ABSTRACT

A project conducted several years ago to develop informal mathematical learning experiences at kindergarten level is compared with the results of the work-book type (formal) program being used at that time. It is hypothesized that kindergarten pupils who study mathematical concepts in a planned, sequential, systematic, but non-workbook (informal) type program will gain more in mathematical concepts and skills than kindergarten pupils who study mathematical concepts as they are presented in a workbook program. Two groups of pupils (experimental and contrast) were used to compare the results of both programs by administering an evaluation instrument. The groups were comparable in age, attending the same school and sessions, had similar socioeconomic backgrounds, were taught by the same teacher, and were similar in levels of general ability. The abilities measured by three sub-tests of matching, number, and copying were regarded to be related to mathematical skills, knowledge and understanding. The comparative tests indicate that children in the experimental group: were better in matching skills; had greater number knowledge and skills; and were better in motor control skills than children in the contrast group. It is concluded that informal learning activities and experiences can be successful in helping young children learn mathematics, and that efforts to develop such activities and experiences should be continued. (Author/LS)

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AN ACTIVITIES AND MATERIALS BASED, NON-TEXT MATHEMATICS PROGRAM FOR KINDERGARTEN

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This report is not a description of a recent research project. The study activities occurred several years ago. The project was not intended originally as a research project, but as a continuation of efforts to study and to develop informal mathematical learning experiences for young children. These particular efforts were at the request of and with the encouragement of the kindergarten teacher involved (Mrs. H. Lerch).

The major purpose of the project was to develop and try out a sequence of learning experiences in mathematics at the kindergarten level which met the criteria of informality established by the kindergarten teacher and the writer of the program. A secondary concern, requested by the administration of the school system involved and prompted by the interests of the program planner, was to compare the results of this program (or sequence of learning experiences) with the results of the workbook-type program then being used in the system. Neither a description of the experimental program nor the comparative findings have been submitted for publication. The activities and learning experiences in the program were considered to be only a part of greater efforts to develop a more complete informal elementary mathematics program, and the findings, although they might have been read and cited, would be quite meaningless without a comprehensive description of the treatment.

In order to compare the results of the two programs, two groups of pupils were needed: an experimental group which studied mathematical concepts in the developed sequence of informal learning experiences, and a contrast group which studied mathematical concepts in a more formal workbook-type program. The statistical analysis was of a post-test only design. Both groups were administered an evaluative instrument (a standardized device) upon completion of their kindergarten program and scores on this test were used for statistical comparisons.

The two groups were comparable in terms of range in chronological age and mean chronological age. The groups might also be considered comparable in that: (1) Each group was comprised of the children in a morning and in an afternoon kindergarten session attending the same school. The contrast group attended during one school term, and the experimental group attended the same school during the succeeding school term. (2) Children in both groups came from the same attendance area and were similar in socioeconomic backgrounds. (3) Both groups were taught by the same teacher. (4) The groups were also observed to be similar in levels of general ability. This similarity was ascertained by teacher observation during the kindergarten program and by scores on the sub-tests of a standardized instrument administered at the end of the program. In addition, care was taken to assure that similar amounts of time were spent on the development of mathematical concepts in both groups.

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Perhaps the major characteristic of the experimental sequence of mathematical learning experiences was an avoidance of the paper-pencil work activities associated with formal workbook-type programs and programs dominated by "ditto-sheet" exercises. The activities of drawing and coloring as a part of the mathematics program were also avoided. Activities and experiences in the informal program were based upon pupil participation in manipulation of objects and in oral discussions. As in other contemporary programs, meaning and understanding of mathematical concepts were emphasized through representation or illustration with real, movable objects. Children were encouraged to ascertain for themselves elementary facts and to develop their own generalizations.

The major portion of the program was devoted to the development of number concepts. Characteristics of our number system such as number names, number symbols, value, base, and positional value were introduced and developed on an elementary level. Insofar as possible, rote counting was ignored. The number property of collections of objects was emphasized and group recognition of small collections was stressed. Children were encouraged to use several different names for the same number by using the words "and" and "less than." Rational counting was taught as a part of a manipulative procedure involving the idea of "and one more." Ordinal number names were introduced only to help children communicate about the position of an object in a collection of objects.

Some activities dealt with the development of elementary geometric ideas utilizing a non-metric approach. In general those ideas were concerned with the recognition, identification, classification, and naming of certain geometric entities with an emphasis upon the characteristics of those entities. Physical models for the entities were utilized for manipulation and to stimulate discussion. The language of the children was used to describe the situations of such major ideas as congruence (same size, same shape), similarity (same shape, different size), perpendicularity (square corner), and parallelism (will never meet).

The general instructional procedure was for the teacher to arrange a "center of interest" around which she and all of the children would gather to describe and discuss the objects in the center, manipulate the objects, and further discuss the new arrangements. Then the children would move into small group or individual settings tp pursue the ideas at different levels, in different approaches, or in different directions. During this part of the activities, the teacher would move about to stimulate discussion, to restructure the situation, or to develop a new question.

Only after children could communicate about an idea through listening, speaking, and doing were written and drawn symbols representing the idea introduced. And, only after children were able to recognize symbols and associate those symbols with the number or geometric idea represented were they asked to reproduce or write the symbols. The general sequence of developing communication skills about mathematical ideas was thus listening, speaking, reading, writing.

Each new learning was built upon previous learnings or understandings as demonstrated by pupil performance, and relationships of ideas and concepts were emphasized. Children were guided to develop ideas and understandings for themselves, to form their own definitions and rules, and to use anyacceptable methods of problem solution.

The planned experimental program was conducted during the latter half of the school year. Activities or lessons were conducted three days per week and ranged in length from ten to twenty-five minutes. Individual activities or lessons were planned as sequential parts within units of study. Units of study included at the appropriate level: objects and comparisons of objects; collections of objects and comparisons of the number size of collections of objects; cardinal number or the number property of collections of objects; ordinal number or the position of objects in a collection; non-metric geometry; and, the base and positional value characteristics of our system of numeration.

The workbook used by the contrast group was one of the more popular programs of the time. The teacher's guide accompanying the workbook stated that the program was planned to meet the needs of children learning to read, write, and understand numbers; was composed of tested classroom material organized in a definite plan; introduced each number with the counting of concrete objects; did not present number symbols until children understood the number concepts; utilized testing to help teachers recognize individual needs; and, aroused and retained number interests through various number games and stories. The design, illustrations, and activities of the program were intended to make number learning a pleasant experience for children.

The program for the contrast group was also conducted during the latter half of the school year. (In both groups, incidental number experiences did occur in the regular school activities during both halves of the school year.) The activities or lessons were conducted by the teacher in the planned sequence of the workbook program. Lessons were presented either three or four days per week. Individual differences were considered in that children were allowed to proceed at their own rate in the workbook. As a result, some children completed the workbook before the end of the year, and some were not able to complete it because of difficulty in understanding the material, lack of motor development necessary for the writing and drawing required, disinterest or dislike of the program, or other reasons not readily discerned by the teacher.

The data gathering instrument used as a post-test (at the end of kindergarten) was comprised of six separate sub-tests designed for the testing of the abilities and understandings of pupils at the end of the kindergarten year or at the beginning of the first grade. Mean scores and measures of variability were computed for both groups on each of the six sub-tests. Measures on the sub-tests or word meaning, sentences, and information were used only to determine whether the two groups might be considered comparable in these areas. As stated previously, the two groups were not different in these areas.

The abilities measured by the three sub-tests of matching, number, and copying were regarded to be related to mathematical skills, knowledge and understandings. The group means and variances on these tests were used to test the null hypothesis implied by the research hypothesis that kindergarten pupils who study mathematical concepts in a planned, systematic, sequential, but non-workbook (informal) type program will gain more in mathematical concepts and skills than kindergarten pupils who study mathematical concepts as they are presented in a workbook program. The mean scores of the two groups on each of the three sub-tests were statistically compared by using an appropriate formula for the t-test and the .05 level of significance.

Those comparative tests indicated that:

1. Children in the experimental group were better in matching skills than children in the contrast group.

2. Children in the experimental group had greater number knowledge and skills than children in the contrast group.

3. Children in the experimental group were better in motor control skills than children in the contrast group.

The kindergarten pupils who studied mathematical concepts in the more informal program gained more in mathematical concepts and skills than the kindergarten pupils who studied mathematical concepts as they were presented in the more formal workbook program.

The major conclusions arrived at by this writer were that informal learning activities and experiences can be successful in helping young children learn mathematics, and that efforts to develop such activities and experiences should be continued. Continuation of those efforts has involved:

1. Revision and retrial of the activities and experiences in the described program in a variety of kindergarten situations.

2. Expansion of the informal learning experiences to include the major part of the K-6 mathematics program. This expansion has led to:

   a. a conceptual reorganization of the scope of the K-6 mathematics program into the major areas of numeration and notation, operations on collections of objects, operations on number, geometric concepts, and measurement, and

   b. a planning of informal learning experiences which fall into the categories of activities, projects, and games.

Efforts to select, plan, and develop informal learning experiences in the form of activities, projects, and games in the major areas previously cited are continuing. As ideas for those informal experiences emerge, they are tried in school situations with children of varying ages and abilities. It is hoped that the informal learning experiences can be so prepared that teachers seeking informal, open, or highly individualized programs for children will be able to utilize the product without losing the original informality.

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